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Electromagnetic Fields and the Public: EMF Standards and Estimation of Risk

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Abstract. Mobile communications are a relatively new and additional source of electromagnetic exposure for the population. Standard daily mobile-phone use is known to increase RF-EMF (radiofrequency electromagnetic field) exposure to the brains of users of all ages, whilst mobile-phone base stations, and base station units for cordless phones, can regularly increase the exposures of large numbers of the population to RF-EMF radiation in everyday life. The need to determine appropriate standards stipulating the maximum acceptable short-term and long-term RF-EMF levels encountered by the public, and set such levels as general guidelines, is of great importance in order to help preserve the general public's health and that of the next generation of humanity.

1. Introduction

Electromagnetic conditions in the environment have changed greatly within the past 15 years. This is in part due to the introduction of mobile telecommunication systems, which have essentially changed the degree of electromagnetic exposure members of the general public are exposed regularly to.

Radiation from mobile-phone communications devices - *and others forms of cordless communications technology* - present completely new electromagnetic exposure regimes for the general population. As examples of this, the daily use of mobile phones is shown to increase RF-EMF (radiofrequency electromagnetic field) exposure to users' brains unless special precautions are taken, and the operation of wireless devices and mobile-phone base-stations can dramatically increase the exposures of large portions of the public to RF-EMF radiation.

The requirement to develop appropriate standards stipulating maximum acceptable short-term and long-term RF-EMF exposure levels for the general public (and it is argued, for vulnerable subsets of the public such as children and pregnant women), and set such levels as general guidelines appears of great importance particularly when technological advances are being made so quickly. Such measures promptly undertaken can help ensure the development of appropriate communications technology

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whilst safeguarding the general public's health and that of future generations. We do not have the right to make mistakes on such a major issue through complacency.

2. Characteristic Conceptions of Russian and Foreign Standards

For the development of appropriate standards that take health and wellbeing into account; it appears necessary to formulate the hygiene hypothesis as follows:

"*The hygienic standards are for the protection of the population, taking into account factors potentially harmful to health, and with the obligation of taking into account typical prevalence of these factors in the general population*" [1].

2.1 International Standards

It is important to consider existing international standards and how these conform to this postulate. Presently international standards are determined by ICNIRP, IEEE, CENELEC and other national and international commissions. The first three organisations mentioned determined the basis for their standards some years ago, and continue to propose RF-EMF guidelines that only take into account thermal, acute and pathological effects [2, 3, 4]. Unfortunately, these RF-EMF standards do little to provide protection for the general population.

With regard to international standards and likely exposures, it is imperative to recognise that the general population is not typically exposed to thermal levels in the workplace or in everyday life. The establishment of a proposed threshold level for pathological effects presently makes the assumption that compensative or adaptive reactions will occur in an organism. However we strongly disagree with this assumption. Whilst people very rarely receive acute exposures in everyday life, all populations in the world have are chronically exposed on a daily basis to low levels of RF-EMF that can cause biological effects and standards have to be set accordingly to take this into account [5].

2.2 National Standards

The RF-EMF exposure levels deemed acceptable vary greatly between countries. As noted in the BioInitiative Report [6] for the RF frequency range of 800-900 MHz, exposure levels range from 4 $\mu W/cm^2$ (0.04 W/m^2) in Switzerland, 6 $\mu W/cm^2$ (0.06 W/m^2) in China, and 10 $\mu W/cm^2$ (0.1 W/m^2) in Russia and Italy to 580 $\mu W/cm^2$ (5.8 W/m^2) in the United States and 5800 $\mu W/cm^2$ (58.0 W/m^2) in the United Kingdom.

2.3 The Russian RF-EMF standards

First of all, it is necessary to provide background information to the reader on the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP). The RNCNIRP was created in 1997 at the Russian Academy of Medical Science (RAMS) within the framework of the Russian Scientific Commission on Radiation Protection (RSCRP). The RSCRP acts as the overseer of the RNCNIRP.

The RNCNIRP employs 40 specialists, of whom 38 are qualified scientists, and 2 members are representatives of the Ministry of Health. The RNCNIRP is an independent scientific organisation which does not accept financial sponsorship. Its decisions are thought of as recommendations, and are considered by the Ministry of Health of the Russian Federation when it is setting standards [7].

Mandatory compliance is required with regard to the Sanitary Provisions and Ecological Norms (SanPiN) guidelines set by the Ministry of Health of the Russian Federation. The latest RF-EMF SanPiN 2.1.8/2.2.4.1190-03 (safety standard) on mobile communications was issued by the Ministry of Health of the Russian Federation in 2003. This decreed that the maximum permissible exposure level for RF-EMF over the frequency range of 300 MHz – 300 GHz in the Russian Federation is 10 $\mu W/cm^2$ (0.1 W/m^2). This SanPiN also recommended that:

"*Use of mobile telecommunication devices should be restricted for those under 18 years of age and pregnant women*" [8].

3. Limitations of Present Standards in Russia and Abroad

There are no publications that present ways of extrapolating from the various existing standards recommendations to properly assess real environmental conditions for the population. There are also currently no proposals on how to estimate danger by using existing international standards recommendations: from acute influences to chronic exposure, and from thermal levels to non-thermal levels.

The methodology used to create standards in Russia (and formerly the USSR, the former Soviet Union) uses principles based on additional factors found during actual EMF exposure of the population. These take into account:

- non-thermal levels;
- chronic exposures;
- establishment of 'working levels', instead of 'threshold levels'.

Consideration is also taken into account of the presence of adaptation processes from chronic exposures instead of direct pathological effects.

4. Database for Standardisation

The results of research undertaken in industrial settings from 1950 onwards – almost 60 years of data – and chronic exposure experiments, etc., provide the database used for Russian (and formerly USSR) standardisation. The necessity of developing standards for children as new risk group is also now recognised, as is the need for need for collecting data on how they are affected by typical exposures.

The potential health risk for children is very high and creates a completely new problem we urgently need to address. As noted by the WHO:

"*Children are different from adults. Children have a unique vulnerability. As they grow and develop, there are 'windows of susceptibility': periods when their organs and systems may be particularly sensitive to the effect of certain environmental threats*" [9].

Modern children will generally use mobile phones for a longer overall period than adults of the present generation because they have started to use them at earlier age and will continue use such technology when they become adults. For a variety of reasons it is impossible to use data obtained on adults as an accurate predictor for effects on children. It is therefore necessary to develop standards which take into consideration localised brain exposures as related to age and undertake corresponding research. There are presently no studies investigating the effects of chronic RF-EMF exposure to the brain area which take into account investigation of the possible effects of such exposures in the developing brain an area we hope to address in future work.

5. Thermal and Non-Thermal Health Effects

Presently there is a refusal by many western scientists to accept the possibility of the existence of detrimental non-thermal RF-EMF effects, which in consequence has resulted in an under estimation

of the actual dangers that may exist to the health of the population through different degrees of RF-exposure. However there are a very large number of publications by scientists from both the east and the west documenting biological effects from low levels of RF-EMF.

As examples of this, reference is made to the following: the BioInitiative Report which was authored by 14 respected scientists from five countries (Austria, China, Denmark, Sweden and the USA) [6], the Stewart Report in the United Kingdom [10], and the US National Academy of Sciences National Research Council [11].

Numerous peer-reviewed studies covering non-thermal biological effects have been made by scientists in Russia (previously the USSR) [12-14]. Analysis of 28 biological experiments conducted *in vitro*, *in situ*, and *in vivo* by the present author from 1975 onwards in the former Soviet Union, and later in Russia, using modulated RF-EMF allows the following basic conclusions to be made:

- exposure of biological systems to EMF with higher or lower composite regimens of modulation can lead to the possible development of both physiological and unfavourable biological effects, that are distinct from the biological effects induced by non-modulated EMF;
- acute exposure to low intensities of modulated EMF (at non-thermal levels) can result in development of pathological effects;
- there is a dependence of development of a reciprocal biological response on the intensity and directness of the concrete regimen of EMF modulation; this dependence was fixed at all levels of biological systems — *in vitro*, *in situ*, and *in vivo*;
- as a rule, modulated EMF invokes more recognisable biological effects than continuous EMF regimes.

6. Unsolved Problems in Estimating Future RF-EMF Risk

With the creation of new conditions new potential problems arise:

- Problems of accumulation of effect, remote somatic effects and cancer.
- Problems of adaptation.
- Estimation of the influence of simultaneous exposure to various frequencies.
- Estimation of the role of signal modulation.
- Coordination of the criterion to establish a threshold or appropriate ‘working level’.
- Changing reactivity and appearance of electromagnetic hypersensitivity.
- Modulation and biological effects.

Such challenges indicate the benefits of extending research into the biological effects of RF-EMF as early as possible when potential new conditions arise.

7. Guaranteeing Good Health for the Population – A Discussion

The present scientific thinking and basis used in many instances for developing appropriate RF-EMF safety standards does not correspond realistically to modern conditions of RF-EMF exposure as experienced by members of the public (both for generalized exposures and through direct use of mobile communication systems technologies).

- From what we now know, existing safety standards (both foreign and Russian) have become outdated. Modern accumulative RF-EMF exposures have also increased considerably from those found in the past, thereby further increasing likely risk.

- The existing standards cannot guarantee the safe, healthy development of the next generation of humanity.

The viewpoint of the Mobile Manufacturers Forum (MMF) - an international association of radio communications equipment manufacturers – differs from that of ourselves and is as follows:

"*the MMF believes that there is a strong scientific basis for all consumers to have confidence in the safety of mobile phones and base stations. In addition, we fully support parents deciding for themselves whether they want their children to use a mobile phone or not*." [15].

We make no comment on this large divergence in viewpoint from that of our own researchers and ask you to make your own assumptions as to why there may be such a difference in opinions!

8. Our Conclusions

We propose that it is of the greatest necessity to undertake appropriate detailed research and accumulate suitable knowledge for preparing proper precautionary standards based on the best available scientific evidence at the earliest possible opportunity.

As part of this work it would be advisable to:

- study the possible effects of repeated RF-EMF exposures from mobile phone use (and exposure to RF-emitters) over periods of several years on the brains of children, teenagers and adult users. It is proposed that the childhood studies should monitor subjects from the age of seven onwards;

- develop and undertake new long-term standardization measures, including measures related directly to suitable exposure levels for children;

- put forward more rigid requirements for industries using technologies operating over such frequency ranges;

- actively introduce, and promote, the adoption of ***proper*** precautionary principles.

The thesis held by some that the present forms of RF communications are absolutely safe is both premature and potentially dangerous. It also holds back the development of more appropriate technologies.

It is necessary to educate scientists, politicians, industries and the general public, including parents and children, that mobile communication devices (and hands-free devices) are not toys, and should be used carefully in a responsible manner. There is no room, or time, for complacency on these matters as related to health, and adopting such measures sooner rather than later could prove highly advantageous to all parties concerned.

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